ECE No. 115

LPG/CNG RETROFIT SYSTEM

Development of Regulation

No.	*Revised*		*Issue Date*	*Effective Date*	*Date Presented by JASIC*	*Remarks*
1.	00		*2003/12/02*	*2003/10/30*	*2004/01/05*	*WP29/924*
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						

Draft

No.	*Revised*		*WP29Document Date of Issue*	*WP29 Doc.*	*Date Presented by JASIC*	*Remarks*

As for the content of this “Automotive Regulations Information”, JASIC has edited the original text of the official gazette issued by the authorities concerned. In spite of every effort to make its edition faithful to the original, there are possibilities that the edited text may contain some inaccuracies in content or in structure. JASIC is not liable for any problems caused by such inaccuracies. Users of this information are advised to refer to the original text of the official gazette itself in case that accuracy is needed.

Japan Automobile Standards Internationalization Center

Regulation No. 115

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF:

I. SPECIFIC LPG (LIQUEFIED PETROLEUM GASES) RETROFIT SYSTEMS TO BE INSTALLED IN MOTOR VEHICLES FOR THE USE OF LPG IN THEIR PROPULSION SYSTEM

II. SPECIFIC CNG (COMPRESSED NATURAL GAS) RETROFIT SYSTEMS TO BE INSTALLED IN MOTOR VEHICLES FOR THE USE OF CNG IN THEIR PROPULSION SYSTEM

CONTENTS

REGULATION
1. Scope
2. Definitions
3. Application for approval
4. Markings
5. Approval
6. Specifications regarding the retrofit systems
7. Instruction manuals
8. Modification and extension of approval of a retrofit system type
9. Conformity of production
10. Penalties for non-conformity of production
11. Production definitely discontinued
12. Names and addresses of technical services responsible for conducting approval tests, and of administrative departments

ANNEXES
Annex 1A-Communication concerning the approval or extension or refusal or withdrawal of approval or production definitely discontinued of a type of LPG retrofit equipment pursuant to Regulation No. 115
Annex 1A - Addendum-Addendum to the communication concerning a type of LPG retrofit equipment pursuant to Regulation No. 115
Annex 1B-Communication concerning the approval or extension or refusal or withdrawal of approval or production definitely discontinued of a type of CNG retrofit equipment pursuant to Regulation No. 115
Annex 1B - Addendum-Addendum to the communication concerning a type of CNG retrofit equipment pursuant to Regulation No. 115
Annex 2A-Arrangement of the LPG retrofit system type approval mark
Annex 2B-Arrangement of the CNG retrofit system type approval mark
Annex 3A-Complete list of information for the purpose of the LPG retrofit system installed on vehicle type approval
Annex 3B-Complete list of information for the purpose of the CNG retrofit system installed on vehicle type approval
Annex 4-Description of the leakage test procedures for CNG/LPG systems installed on vehicles
Annex 5-Prescriptions concerning the fixation of LPG and CNG container(s)

Regulation No. 115

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF:

I. SPECIFIC LPG (LIQUEFIED PETROLEUM GASES) RETROFIT SYSTEMS TO BE INSTALLED IN MOTOR VEHICLES FOR THE USE OF LPG IN THEIR PROPULSION SYSTEM

II. SPECIFIC CNG (COMPRESSED NATURAL GAS) RETROFIT SYSTEMS TO BE INSTALLED IN MOTOR VEHICLES FOR THE USE OF CNG IN THEIR PROPULSION SYSTEM

1. SCOPE

This Regulation applies to:

1.1. Part I :Specific LPG retrofit systems to be installed in motor vehicles for the use of LPG in the propulsion system.
Part II :Specific CNG retrofit systems to be installed in motor vehicles for the use of CNG in the propulsion system.

1.2. This Regulation applies when the retrofit systems manufacturer keep the initial characteristics of the whole system, for the specific vehicle family for which the approval has been granted.

1.3. This Regulation does not apply to the procedures, checks and inspections aimed at verifying the correct installation of the retrofit systems on vehicles, since this matter relies on the competence of the Contracting Party of Country where the vehicle is registered.

1.4. This Regulation applies to retrofit systems intended to be fitted on vehicles of categories M and N.

The requirements for the different categories (M_1, N_1 or others) are defined in paragraphs 2 to 7.

The modified vehicle shall remain conform to all the provisions of the Regulation for which the type approval has been initially granted.

1.5. Safety requirements of this Regulation apply to all vehicles approved.

Emission requirements of this Regulation do not apply to vehicles approved before the application of the requirements of Regulation No. 83, 01 series of amendments [1/].

For vehicles approved before the application of the requirements of Regulation No. 83, 01 series of amendments, [1/] national requirements may be applicable.

Emission requirements of this Regulation do not apply to engines approved before the application of the requirements of Regulation No. 49, 02 series of amendments [2/].

For engines approved before the application of the requirements of Regulation No. 49, 02 series of amendments, [2/] national requirements may be applicable.

2. DEFINITIONS

[1/]Regulation No. 83, 01 series of amendments entered into force on 30 December 1992.
[2/]Regulation No. 49, 02 series of amendments entered into force on 30 December 1992.

2.1. "Approval of an LPG or CNG retrofit system" means the approval of the type of retrofit system to be installed in motor vehicles for the use of LPG or CNG.

2.1.1. Specific LPG retrofit system of an approved type may consist of several components as classified and approved according to Regulation No. 67, 01 series of amendments, Part I and the specific vehicle installation instructions manual.

2.1.2. Specific CNG retrofit system of an approved type may consist of several components as classified and approved according to Regulation No. 110, Part I and the specific vehicle installation instructions manual.

2.1.3. "A vehicle is considered mono-fuel", when it is equipped with a petrol tank of capacity $\leq$ 15 litres, that can only be used to "limp-home".

2.2. "Specific LPG or CNG retrofit system of an approved type" means systems, which do not differ in such respect as:

2.2.1. retrofit system manufacturer (responsible for retrofit approval application);

2.2.2. pressure regulator/vaporiser type by the same manufacturer;

2.2.3. gas fuelling system type by the same manufacturer (i.e. induction mixer, injector device, vapour or liquid, single or multi-point injection system, ...);

2.2.4. sensors and actuators set types from the same manufacturer;

2.2.5. safety device type by the same manufacturer, as required by Regulation No. 67, 01 series of amendments, or Regulation No. 110, where applicable (i.e. relief valve, ...);

2.2.6. fuel container type from the same manufacturer;

2.2.7. fuel container accessories type from the same manufacturer;

2.2.8. fuel container fitting devices;

2.2.9. ECU (Electronic Control Unit) type by the same manufacturer;

2.2.10. basic software principles and system strategy;

2.2.11. installation manual (see para. 7);

2.2.12. end-user service manual (see para. 7).

2.3. "Manufacturer" means an organization which can assume technical responsibility for the manufacturing of LPG and CNG retrofit systems and can demonstrate that it possesses the features required and the necessary means to achieve quality assessment and conformity of production.

2.4. For the purposes of this Regulation, "the parent vehicle", with regard both to LPG system and to CNG system, means a vehicle that is selected to act as the vehicle, on which the requirements of this Regulation are going to be demonstrated, and to which the members of a family refer.

Note: With respect to paragraphs 2.2.5., 2.2.6., 2.2.7. and 2.2.8., the manufacturer of the retrofit can insert in his installation manual other components, included in the approval, as interchangeable items (see para. 7).

2.4.1. According to this Regulation, "a member of the family" is a vehicle equipped with retrofit system type of which type approval is requested and sharing the following essential characteristics with its parent one:

2.4.1.1.

a) It is produced by the same vehicle manufacturer.
b) It is classified in the same category M_1 or M_2 or M_3 or N_1 or N_2 or N_3. Vehicles of category N_1 may belong to the same family of category M_1 (parent vehicle).
c) It is subject to the same emission limits.
d) If the gas fuelling system has a central metering for the whole engine: it has a certified power output between 0.7 and 1.15 times that of the engine of the parent vehicle. If the gas fuelling system as an individual metering per cylinder: it has a certified a power output per cylinder between 0.7 and 1.15 times that of the engine of the parent vehicle.
e) Fuel feed and combustion process (injection: direct or indirect, single-point or multi-point ....)
f) It has the same pollution control system:
- same type of catalyst if fitted (three-way, oxidation, de NO_x ....)
- air injection (with or without)
- Exhaust gas recirculation (EGR) (with or without)

If the tested vehicle was not equipped with air-injection or EGR, engines with these devices are allowed.

2.4.1.2. Where approval is applied for a vehicle family, as described in paragraph 2.4.1.1. the tests may be limited to at least two vehicles (the maximum and the minimum engine power), selected after agreement with the technical service responsible for approval.

If the family power range is less than 10 per cent, it is possible to test only one vehicle.

2.4.1.3. With regard to requirement (d): in the case where a demonstration shows two gas fuelled vehicles could be members of the same family with the exception of their certified power output, respectively P1 and P2 (P1 < P2), and both are tested as if they were parent vehicles, the family relation will be considered valid for any vehicle with a certified power output between 0.7*P1 and 1.15*P2.

2.5. For definitions of the components of LPG retrofit systems refer to Regulation No. 67, 01 series of amendments.

2.6. For definitions of the components of CNG retrofit systems refer to Regulation No. 110.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a specific retrofit system shall be submitted by the manufacturer or by his duly accredited representative,

3.2. It shall be accompanied by the under-mentioned documents in triplicate and by the following details:

3.2.1. Description of the retrofit system comprising all the relevant details, included the approval numbers of each component referred to in annex 3A to this Regulation for LPG system and annex 3B to this Regulation for CNG system;

3.2.2. Description of the parent vehicle(s) on which the requirements of this Regulation are going to be tested;

3.2.3. Description of all modifications applied to the original parent vehicle, only in case of bi-fuel configuration;

3.2.4. Verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;

3.3. Instruction manual for the retrofit installation on vehicles

3.4. End-user service manual

3.5. A sample of the specific retrofit, properly installed in the parent vehicle(s).

4. MARKINGS

4.1. The sample(s) of a specific retrofit system submitted to type-approval shall be accompanied by a plate with the trade name or mark of the retrofit manufacturer and the type, as indicated in annexes 2A and 2B.

4.2. All retrofit systems, installed in the vehicle belonging to the family, as defined in paragraph 2, shall be identified by a plate, in which the approval number, and the technical specifications, as required in annexes 2A and 2B shall be placed. This plate has to be permanently fixed to the structure of the vehicle and shall be clearly readable and indelible.

5. APPROVAL

5.1. If the retrofit system sample submitted for approval meets the requirements of paragraph 6 of this Regulation, the type approval of the retrofit system shall be granted.

5.2. An approval number shall be assigned to each type of the retrofit system approved. Its first two digits (at present 00 according to the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same type approval number to another type of retrofit system.

5.3. Notice of approval or of refusal or of extension of approval of a retrofit system type/part pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annexes 1A and 1B to this Regulation.

5.4. An international approval mark shall be affixed in the plate as indicated in annexes 2A and 2B, to all retrofit systems, conforming to a type approved under this Regulation, in addition to the mark prescribed in this paragraph 4.1. This approval mark shall consist of:

5.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted the approval [3/].

5.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle defined in paragraph 5.4.1. The approval number consists of the retrofit system type approval number, which appears in the communication form for this type (see paragraph 5.2. and annexes 1A and 1B) preceded by two figures indicating the latest series of amendments to this Regulation.

5.5. The approval mark shall be clearly readable and be indelible.

5.6. Annexes 2A and 2B to this Regulation give examples of the arrangement of the aforesaid plate with approval mark.

6. SPECIFICATIONS REGARDING THE RETROFIT SYSTEMS

6.1. PART I - LPG retrofit system specifications:

6.1.1. Requirements for the installation of specific equipment for the use of LPG in the propulsion system of a vehicle

6.1.1.1. An LPG retrofit system shall contain at least the following components:

6.1.1.1.1. Components indicated in Regulation No. 67, 01 series of amendments and defined as necessary,

6.1.1.1.2. Installation manual,

6.1.1.1.3. End-user service manual.

6.1.1.2. The LPG retrofit system may also include components indicated as optional in Regulation No. 67, 01 series of amendments.

6.1.1.3. The LPG retrofit system installed in the vehicle, in a proper way as defined in the above installation manual, shall comply with the installation requirements of Regulation No. 67, 01 series of amendments. Concerning the fixation of the fuel container, the requirements of Regulation No. 67, 01 series of amendments shall be deemed to be met if the requirements of annex 5 to the present Regulation are satisfied.

6.1.2. Gaseous pollutants emissions and CO_2 emissions (for category M_1 vehicles only)

6.1.2.1. One LPG retrofit system sample, as described in paragraph 2 of this Regulation, installed into the parent vehicle, as described in paragraph 2 of this Regulation, shall be submitted to the test procedures described in Regulations No. 83 [4/] and No. 101, or No.

[3/] 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Serbia and Montenegro, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa and 48 for New Zealand. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify the Agreement Concerning the Adoption for Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approval Granted on the Basis of these Prescriptions, and the numbers, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

49, [5/] where applicable. The vehicles and/or the engines are also submitted to a maximum power comparison test, as described in Regulation No. 85 for engines, or defined in paragraph 6.1.3. below for vehicles.

6.1.2.2. Fuel requirements by the engine: the type of fuel normally used by the engine could be:

(a) LPG only
(b) both unleaded petrol or LPG
(c) both leaded petrol or LPG
(d) both diesel fuel or diesel fuel and LPG.

6.1.2.3. "Gaseous pollutants" means:

(i) carbon monoxide
(ii) hydrocarbons assuming a ratio:
$CH_{1,85}$ for petrol
$CH_{1,86}$ for diesel fuel
$CH_{2,52}$ for LPG
CH (to be defined) for dual fuel;
(iii) oxides of nitrogen, the latter being expressed in nitrogen dioxide (NO_2) equivalent.

6.1.2.4. Exhaust emissions (M_1 and N_1 categories of vehicles and CO_2 emissions M_1 category vehicles):

The parent vehicle(s) are submitted to the test indicated in Regulation No. 83 [4/] as follows:

Type I: three measurements of tailpipe emissions after a cold start with each fuel:

(i) reference petrol,
(ii) reference LPG A,
(iii) reference LPG B.

The emissions of CO, HC, NO_x and HC + NO_x are calculated according Regulation No. 83. [4/].

The test vehicle(s) with the reference petrol shall comply with the limit values according to the type approval of the vehicle(s) including the deterioration factors applied during the type approval of the vehicle(s).

The requirements regarding emissions of the vehicle(s) equipped with the retrofit system, and with the two reference gases, shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC + NO_x) the following conditions:

(1) $(MA + MB)/2 < 0.85S + 0.4G$
(2) MA and MB < G

where:

MA: mean value of the emissions of one pollutant (CO/HC/NO_x) [4/] or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and with LPG A,

MB: mean value of the emissions of one pollutant (CO/HC/NO_x) [4/] of the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and

[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.
[4/] According to Regulation No. 83, the series of amendments in force during the initial type approval of the engine.

with LPG B,

S: mean value of the emissions of one pollutant ($CO/HC/NO_x$) [4/] or the sum of two pollutants ($HC + NO_x$) obtained from the three Type I tests with the reference petrol,

G: limit value of the emissions of one pollutant ($CO/HC/NO_x$) [4/] or the sum of two pollutants ($HC + NO_x$) according to the type approval of the vehicle(s) divided by the deterioration factors.

The emissions of CO_2 are calculated according to Regulation No. 101 for each parent vehicle.

The mean of CO_2 emissions shall be calculated as follows:

$$CO_{2LPG} = 1/n \sum_{i=1}^{n} (CO_{2Ai} + CO_{2Bi}) / 2$$

$$CO_{2petrol} = 1/n \sum_{i=1}^{n} CO_{2petrol.i}$$

where:

i: number of parent vehicles (i = 1 to n)

CO_{2Ai}: mean value of the emissions of CO_2 obtained from the three Type I tests with the retrofit system and with LPG A for vehicle No. i,

CO_{2Bi}: mean value of the emissions of CO_2 obtained from the three Type I tests with the retrofit system and with LPG B for vehicle No. i;

$CO_{2petrol.i}$: mean value of the emissions of CO_2 obtained from the three Type I tests with reference petrol for vehicle No. i.

The ratios of CO_2 emissions and fuel consumption shall be calculated as follows:

$$K_{CO2} = CO_{2LPG} / CO_{2petrol}$$

$$K_{Cons} = Cons_{LPG} / Cons_{petrol}$$

for each vehicle of the family, the official values of CO_2 emissions are multiplied by the above ratios.

6.1.2.5. Exhaust emissions (M_2, M_3, N_2 and N_3 categories of vehicles)

The parent engine(s) are submitted to the tests indicated in Regulation No. 49 [5/] as follows:

Measurements of emissions in the 13-mode cycle with each fuel:

(i) reference diesel fuel,
(ii) commercial LPG.

[4/] According to Regulation No. 83, the series of amendments in force during the initial type approval of the engine.
[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.

The emissions of CO, HC, NO_x and particulates are calculated according to Regulation No. 49 [5/].

The test engine(s) with the reference diesel fuel shall comply with the limit values according to the type approval of the engine(s) applied during the type approval.

The requirements regarding emissions of the engine(s) equipped with the retrofit system, and with the LPG, shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC, NO_x and particulates) the following conditions:

(1) $M < 0.85S + 0.4G$
(2) $M < G$

M: value of the emissions of one pollutant obtained from the 13-mode test with the retrofit system and with LPG,

S: value of the emissions of one pollutant obtained from the 13-mode test with the reference diesel fuel,

G: limit value of the emissions of one pollutant according to the type approval of the engine(s)

6.1.3. Power requirements

The parent vehicle(s) or engine(s) are submitted to the tests as follows:

6.1.3.1. One LPG retrofit system sample as described in paragraph 2 of this Regulation, installed in the parent vehicle(s) or on the parent engine(s) shall be submitted to the test procedures of paragraph 6.1.3.2. or 6.1.3.3.

6.1.3.2. Chassis dynamometer method:

The maximum power at the wheels is measured on a chassis dynamometer on each parent vehicle with the following fuels:

(i) reference petrol,
(ii) reference LPG A or B,

The measured power with LPG shall be lower than that measured with petrol + 5 per cent.

The mean of power measurements shall be calculated as follows:

$$Power_{petrol} = 1/n \sum_{i=1}^{n} Power_{petrol.i}$$

$$Power_{LPG} = 1/n \sum_{i=1}^{n} Power_{LPG.i}$$

The ratio of engine power shall be calculated as follows:

$$K_{power} = Power_{LPG} / Power_{petrol}$$

[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.

For each vehicle of the family, the official values of engine power are multiplied by the above ratio.

6.1.3.3. Engine dynamometer method:

The maximum power at the crankshaft is measured on an engine dynamometer according to Regulation No. 85 for each parent vehicle(s) with the following fuels:

(i) commercial petrol or diesel fuel,
(ii) commercial LPG,

The mean of power measurements shall be calculated as follows:

$$\text{Power}_{\text{petrol}} = 1/n \sum_{i=1}^{n} \text{Power}_{\text{petrol.i}}$$

$$\text{Power}_{\text{LPG}} = 1/n \sum_{i=1}^{n} \text{Power}_{\text{LPG.i}}$$

The ratio of engine power shall be calculated as follows:

$$K_{\text{power}} = \text{Power}_{\text{LPG}} / \text{Power}_{\text{petrol}}$$

For each vehicle of the family, the official values of engine power are multiplied by the above ratio.

6.2. PART II - CNG retrofit system specifications:

6.2.1. Requirements for the installation of specific equipment for the use of compressed natural gas (CNG) in the propulsion system of a vehicle

6.2.1.1. A CNG retrofit system shall contain at least the following components:

6.2.1.1.1. Components indicated in Regulation No. 110 and defined as necessary,

6.2.1.1.2. Installation manual,

6.2.1.1.3. End-user service manual.

6.2.1.2. The CNG retrofit system may also include components indicated as optional in Regulation No. 110.

6.2.1.3. The CNG retrofit system installed in the vehicle, in a proper way as defined in the above installation manual, shall comply with the installation requirements of Regulation No. 110. Concerning the fixation of the fuel container, the requirements of Regulation No. 110 shall be deemed to be met if the requirements of annex 5 to the present Regulation are satisfied.

6.2.2. Gaseous pollutants emissions and CO_2 emissions (for category M_1 vehicles only)

6.2.2.1. One CNG retrofit system sample, as described in paragraph 2 of this Regulation, installed into the parent vehicle as described in paragraph 2 of this Regulation, shall be submitted to the test procedures described in Regulations Nos. 83 [4/] and No. 101, or No.

49 [5/], where applicable.

The vehicles and/or the engines are also submitted to a maximum power comparison test, as described in Regulation No. 85 for engines or defined in paragraph 6.2.3. below for vehicles.

6.2.2.2. Fuel requirements by the engine, the type of fuels normally used by the engine:

(a) CNG only
(b) both unleaded petrol or CNG
(c) both leaded petrol or CNG
(d) both diesel fuel or diesel fuel and CNG

6.2.2.3. "Gaseous pollutants" means:

(i) carbon monoxide
(ii) hydrocarbons assuming a ratio
$CH_{1,85}$ for petrol
$CH_{1,86}$ for diesel fuel
CH_4 for CNG
CH (to be defined) for dual fuel;
(iii) oxides of nitrogen, the latter being expressed in nitrogen dioxide (NO_2) equivalent.

6.2.2.4. Exhaust emissions (M_1 and N_1 categories of vehicles and CO_2 emissions M_1 category vehicles):

The parent vehicle(s) are submitted to the tests indicated in Regulation No. 83 [4/], as follows:

Type I: three measurements of tailpipe emissions after a cold start with each fuel:
(i) reference petrol,
(ii) reference G2O fuel,
(iii) reference G25 fuel.

The emissions of CO, HC, NO_x and HC + NO_x are calculated according to Regulation No. 83 [4/].

The test vehicle(s) with the reference petrol shall comply with the limit values according to the type approval of the vehicle(s) including the deterioration factors applied during the type approval of the vehicle(s).

The requirements regarding emissions of the vehicle(s) equipped with the retrofit system, and with the two reference gases, shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC + NO_x) the following conditions:
(1) $(MG20 + MG25)/2 < 0.85S + 0.4G$
(2) MG20 and MG25 < G

where:

MG20: mean value of the emissions of one pollutant (CO/HC/NO_x) [4/] or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and with fuel G20,

MG25: mean value of the emissions of one pollutant (CO/HC/NO_x) [4/] or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and

[4/] According to Regulation No. 83, the series of amendments in force during the initial type approval of the vehicle.
[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.

with fuel G25,

S: mean value of the emissions of one pollutant ($CO/HC/NO_x$) [4/] or the sum of two pollutants ($HC + NO_x$) obtained from the three Type I tests with the reference petrol,

G: limit value of the emissions of one pollutant ($CO/HC/NO_x$) [4/] or the sum of two pollutants ($HC + NO_x$) according to the type approval of the vehicle(s) divided by the deterioration factors.

The emissions of CO_2 are calculated according Regulation No. 101 for each parent vehicle.

The mean of CO_2 emissions shall be calculated as follows:

$$CO_{2CNG} = 1/n \sum_{i=1}^{n} (CO_{2G20i} + CO_{2G25i})$$

$$CO_{2\,petrol} = 1/n \sum_{i=1}^{n} CO_{2\,petrol.i}$$

where:

i: number of parent vehicle (i = 1 to n)

CO_{2G20}: mean value of the emissions of CO_2 obtained from the three Type I tests with the retrofit system and with fuel G20 for vehicle No. i,

CO_{2G25}: mean value of the emissions of CO_2 obtained from the three Type I tests with the retrofit system and with fuel G25 for vehicle No. i,

$CO_{2\,petrol.i}$: mean value of the emissions of CO_2 obtained from the three Type I tests with reference petrol for vehicle No. i.

The ratios of CO_2 emissions and fuel consumption shall be calculated as follows:

$$K_{CO2} = CO_{2CNG} / CO_{2\,petrol}$$

$$K_{Cons} = Cons_{CNG} / Cons_{petrol}$$

For each vehicle of the family, the official values of CO_2 emissions are multiplied by the above ratios.

6.2.2.5. Exhaust emissions (M_2, M_3, N_2 and N_3 categories of vehicles)

The parent engine(s) are submitted to the tests indicated in Regulation No. 49 [5/] as follows:

measurements of emissions in the 13-mode cycle with each fuel:

(i) reference diesel fuel,
(ii) commercial CNG

[4/] According to Regulation No. 83, the series of amendments in force during the initial type approval of the vehicle.
[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.

The emissions of CO, HC, NO_x and particulates are calculated according to Regulation No. 49. [5/]

The test engine(s) with the reference diesel fuel shall comply with the limit values according to the type approval of the engine(s) applied during the type approval.

The requirements regarding emissions of the engine(s) equipped with the retrofit system, and with the CNG, shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC, NO_x and particulates) the following conditions:

(1) $M < 0.85S + 0.4G$
(2) $M < G$

where:

M: value of the emissions of one pollutant obtained from the 13-mode test with the retrofit system and with CNG,

S: value of the emissions of one pollutant obtained from the 13-mode test with the reference diesel fuel,

G: limit value of the emissions of one pollutant according to the type approval of the engine(s).

6.2.3. Power requirements

The parent vehicle(s) or engine(s) are submitted to the tests as follows:

6.2.3.1. One CNG retrofit system sample as described in paragraph 2 of this Regulation, installed in the parent vehicle(s) or on the parent engine(s) shall be submitted to the test procedures of paragraph 6.2.3.2. or 6.2.3.3.

6.2.3.2. Chassis dynamometer method:

The maximum power at the wheels is measured on a chassis dynamometer for each parent vehicle with the following fuels:

(i) reference petrol,
(ii) reference fuel G20 or G25

The measured power with CNG shall be lower than that measured with petrol +5 per cent.

The mean of power measurements shall be calculated as follows:

$$\text{Power}_{\text{petrol}} = 1/n \sum_{i=1}^{n} \text{Power}_{\text{petrol.i}}$$

$$\text{Power}_{\text{CNG}} = 1/n \sum_{i=1}^{n} \text{Power}_{\text{CNG.i}}$$

[5/] According to Regulation No. 49, the series of amendments in force during the initial type approval of the engine.

The ratio of engine power shall be calculated as follows:

$$K_{power} = Power_{CNG} / Power_{petrol}$$

For each vehicle of the family, the official values of engine power are multiplied by the above ratio.

6.2.3.3. Engine dynamometer method:

The maximum power at the crankshaft is measured on an engine dynamometer according to Regulation No. 85 for each parent vehicle(s) with the following fuels:

(i) commercial petrol or diesel fuel,
(ii) commercial CNG,

The mean of power measurements shall be calculated as follows:

$$Power_{petrol} = 1 / n \sum_{i=1}^{n} Power_{petrol.i}$$

$$Power_{CNG} = 1/n \sum_{i=1}^{n} Power_{CNG.i}$$

The ratio of engine power shall be calculated as follows:

$$K_{power} = Power_{CNG} / Power_{petrol}$$

For each vehicle of the family, the official values of engine power are multiplied by the above ratio.

7. INSTRUCTION MANUALS

7.1. Instruction manual for the retrofit installation on the vehicle

7.1.1. Scope

The scope of this paragraph is to list the minimum requirements which shall be contained in the installation manual.

7.1.2. List of reference standards:

7.1.3. General requirements

7.1.3.1. The installation manual has the purpose to guide the installer through the correct procedures which shall be observed while assembling the LPG/CNG systems.

7.1.3.2. The installation manual shall be prepared by the retrofit system manufacturer.

7.1.3.3. The installation manual is part of the retrofit system and shall therefore be contained in the conversion kit.

7.1.3.4. The installation manual included in the kit must be written in the language of the country to which the conversion retrofit will be delivered.

7.1.3.5. The installation manual can be divided in two parts:

Part I:

(i) Part containing the description of the sample of retrofit installed on the parent vehicle, and submitted to the tests and inspections of the authority that grants the type approval.

(ii) Part containing the list of components indicated by the retrofit manufacturer as alternatives.

Part II:

(i) Part containing installation instructions, for all the vehicles belonging to the family of the parent vehicle.

7.1.3.6. Part I of the instruction manual has to be submitted to the authority that grants the type approval.

7.1.3.7. Part II of the instruction manual has to be filed by the retrofit system manufacturer for a time to be determined in accordance with the authority that grants the type approval.

7.1.4. Contents of installation manual

7.1.4.1. Retrofit system description

7.1.4.1.1. Retrofit system approval number

7.1.4.1.2. Vehicle manufacturer(s)

7.1.4.1.3. Vehicle category

7.1.4.1.4. Vehicle type

7.1.4.1.5. Engine type

7.1.4.1.6. Engine displacement

7.1.4.1.7. Transmission type

7.1.4.1.8. Vehicle model

7.1.4.1.9. Type of conversion retrofit (LPG or CNG)

7.1.4.1.10. Assembly instruction number

7.1.4.1.11. General scheme of the retrofit system containing the following information of each component.

(a) identification number
(b) manufacturer's code
(c) type approval (if it exists)
(d) for the containers: capacity/manufacturer/type/date of expiry or replacement date.

7.1.4.1.12. Drawings of the fitting devices of the container installation on the vehicle.

7.1.4.2. Installation instructions

7.1.4.2.1. Assembly instructions of the various components together with detailed diagrams or photographs showing clearly the layout of the single components within the engine compartment.

7.1.4.2.2. Instructions indicating the exact position where the installer shall place the retrofit system type approval plate (contained in the conversion kit).

7.1.4.2.3. Detailed wiring diagram of the electrical system containing the mechanical components to which the wires shall be connected.

7.1.4.2.4. Scheme of the layout of the electrical components within the engine compartment showing the detailed disposition of the wiring.

7.1.5. Proper assembly check

7.1.5.1. The installation manual shall contain the detailed procedures and actions which must be taken by the installer to check whether the system has been assembled in order to safely perform and to abide by the installation instructions.

7.1.6. Start-up procedures

7.1.6.1. The installation manual shall contain the start-up operations which must be performed by the installer.

7.1.7. Service instructions

7.1.7.1. The installation manual shall contain the maintenance schedule in which all the ordinary service (type) which the single components as well as the system must undergo through their working life (time in km covered by the vehicle) will be specified.

7.1.7.2. The installation manual must specify the expertise necessary for the installation/service of the system.

7.1.8. System malfunction

7.1.8.1. The installation manual shall contain the actions which must be taken in case the system malfunctions.

7.1.9. Diagnosis

7.1.9.1. If a diagnosis system is included in the conversion kit, the installation manual shall contain a detailed description of such a system together with the corrective actions which may be taken in case of malfunctioning.

7.2. <u>End-User Service Manual</u>

7.2.1. Scope

To specify the minimum requirements of the end-user manual for LPG/CNG systems maintenance.

7.2.2. General requirements

7.2.2.1. The user manual has the purpose to inform the end-user about the characteristics and safety features of the installed LPG/CNG systems.

7.2.2.2. The user manual shall be prepared by the manufacturer of the retrofit system.

7.2.2.3. The manufacturer of the system shall include all the necessary information that is needed for correct use and safe operation of the LPG/CNG systems.

7.2.2.4. The user manual shall be considered as an integral part of the system and therefore be delivered with the LPG/CNG systems.

7.2.4.5. The user manual shall be written in the language of the country to which the system is delivered.

7.2.4.6. The user manual shall indicate reference to the product type and version and production year for which it is applicable.

7.2.4.7. Information shall be given for relevant extreme ambient conditions.

7.2.5. Contents of the end-user service manual

7.2.5.1. Technical specifications

The user manual shall contain at least the following information:
(a) Operating characteristics
(b) Performance under normal operating conditions
(c) Extreme ambient conditions.

7.2.5.2. Safety instructions

The user manual shall give warning for dangers to health and safety categorised in the following way:
(a) SUGGESTIONS for optimal use of the system
(b) ATTENTION for possible problems due to misuse
(c) WARNING for damage to persons or goods when procedures are not followed.

If and when safety symbols are used, they shall be in accordance with the international system, SI and their purpose must be clearly specified in the user manual.

The user manual shall indicate proper actions to be taken in case the vehicle is repainted and put in a hot drying cabin.

7.2.5.3. LPG/CNG systems description

All the components of the LPG/CNG systems shall be clearly described for their purpose, use and function.

7.2.5.4. First use and adjustment of the LPG/CNG systems

The user manual shall contain all the necessary information to the end user about initial running in and or adjustment of the system when needed.

7.2.5.5. Operating of the LPG/CNG systems

7.2.5.5.1. Filling of the LPG/CNG systems

The user manual shall indicate the sequence of operations needed to fill up the LPG/CNG containers. Particular attention must be paid to the maximum filling level of the 80 per cent in case of LPG.

7.2.5.5.2. Switch-over procedure

The user manual shall clearly describe the method of switching over from one to the other alternative fuel by giving the sequence of operations.

7.2.5.5.3. Opening/closing of manual valves

When fitted, the user manual shall indicate the proper procedure to operate the manual valves.

7.2.5.5.4. Level indicator

The user manual shall state the location of the level indicator, for example at the dashboard or at the container. Its read-out has to be clearly explained to the user, giving particular attention to the 80 per cent filling level in case of LPG.

7.2.5.5.5. Maintenance

If maintenance is required, the user manual shall state the frequency and type of maintenance to be carried out.

7.2.5.5.6. Defects and repair

The user manual shall indicate which actions have to be taken in the case of a defect of the system.

When the system is equipped with a diagnosis system the user manual shall describe this system and indicate proper actions to be taken.

7.2.5.5.7. Scrapping of the product

The user manual shall give proper indication about precautions to be taken when the system has to be removed from the vehicle.

8. MODIFICATION AND EXTENSION OF APPROVAL OF A RETROFIT SYSTEM TYPE

8.1. Every modification of the installation of the specific equipment for the use of compressed natural gas in the propulsion system of the vehicle shall be notified to the authority, which granted the retrofit system type approval. The authority may then either:

8.1.1. Consider that the modifications made are unlikely to have an appreciably adverse effect and that in any case the retrofit system still complies with the requirements, or

8.1.2. Require a further test report from the technical service responsible for conducting the tests.

8.2. In both cases described in paragraphs 8.1.1. and 8.1.2. above, the authority shall be presented in the updated installation manual.

8.3. Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 5.3. above to the Parties to the 1958 Agreement applying this Regulation.

8.4. The competent authority issuing the extension of approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying to this Regulation by means of a communication form conforming to the model in annexes 1A and/or 1B to this Regulation.

9. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, appendix 2 (E/ECE/324 - E/ECE/TRANS/505/Rev.2).

10. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

10.1. The approval granted in respect of a type of retrofit system pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 9 above are not complied with.

10.2. If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the models in annexes 1A and/or 1B to this Regulation.

11. PRODUCTION DEFINITELY DISCONTINUED

11.1. If the holder of the approval completely ceases to manufacture a type of retrofit system approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in annexes 1A and/or 1B to this Regulation.

12. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

12.1. The Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

Annex 1A

COMMUNICATION

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....

concerning:[2/]

APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a type of LPG retrofit equipment pursuant to Regulation No. 115
Approval No.: ..... Extension No.: .....

1. LPG retrofit equipment considered:
Container
Accessories fitted to the container [2/]
80 per cent stop valve
Level indicator
Pressure relief valve (discharge valve)
Pressure relief device (fuse)
Remote controlled service valve with excess flow valve
With/without LPG fuel pump [2/]
Multivalve, including the following accessories: .....
Ventilation housing
Power supply bushing (pump/actuators) [2/]
Fuel pump [2/]
Vaporiser/pressure regulator [2/]
Shut-off valve [2/]
Non-return valve [2/]
Gas tube pressure relief valve [2/]
Service coupling [2/]
Flexible hose [2/]
Remote filling point [2/]
Gas injection device or injector [2/]
Gas dosage unit [2/]
Gas mixing piece [2/]
Electronic control unit [2/]
Pressure/temperature sensor [2/]
LPG filter unit [2/]

[1/]Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).
[2/]Strike out what does not apply.

2. Trade name or mark .....
3. Manufacturer's name and address .....
4. Name and address of manufacturer's representative, if applicable .....
.....
5. Submitted for approval on .....
6. Technical service responsible for conducting approval tests .....
7. Date of report issued by that service .....
8. No. of report issued by that service .....
9. Approval granted/refused/extended/withdrawn [2/] .....
10. Reason(s) of extension (if applicable) .....
11. Vehicle types in which the retrofit system can be installed (M_1 and N_1 categories), or vehicle types in which the retrofit system can be installed (other categories of vehicles) and, if applicable, CO_2 and power ratios (see Addendum to this annex)
11.1. Emission requirements:
Regulation No. 83, ... series of amendments [3/] approval A/B/C [2/]
Regulation No. 49, ... series of amendments [3/]
12. Place .....
13. Date .....
14. Signature .....
15. The documents filed with the application or extension of approval can be obtained upon request.

[2/] Strike out what does not apply.
[3/] Amendment in force at the time of the initial type approval of the vehicle or engine.

Annex 1A - Addendum

ADDENDUM TO THE COMMUNICATION CONCERNING A TYPE OF LPG RETROFIT EQUIPMENT PURSUANT TO REGULATION No. 115

(Approval No. ..... Extension No. .....)

1. Vehicles on which the retrofit equipment has been tested:

Vehicle No.	1	2	n
Make:			
Type:			
Engine:			
Power:			
Category:			

2. Test results:

Ratio CO_{2LPG} /$CO_{2\ petrol}$: [2/] .....
Ratio $Power_{LPG}$ /$Power_{\ petrol\ (or\ diesel)}$: .....

3. Vehicles type(s) for which the retrofit equipment type is qualified:

Fuel		Petrol (or diesel) [1/]		LPG	
Vehicle type	Engine type	Power kW	CO_2 g/km [2/]	Power kW	CO_2 g/km [2/]

[1/] Strike out what does not apply.
[2/] Applicable to category M_1 vehicles only.

Annex 1B

COMMUNICATION

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....

concerning: 2/

APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a type of CNG retrofit equipment pursuant to Regulation No. 115
Approval No: ..... Extension No: .....

1. CNG equipment comprising:
   Container
   Accessories fitted to the container 2/
   Level or pressure indicator
   Pressure relief valve (discharge valve)
   Remote-controlled automatic valve with excess flow valve
   Pressure relief device (fuse)
   Gas-tight housing
   Pressure regulator 2/
   Automatic valve 2/
   Check valve 2/
   Flexible fuel line or hose 2/
   Filling unit 2/
   Gas/air mixer (injector)
   Flow gas adjuster
   Gas/air mixer (carburettor)
   Electronic control unit 2/
   Pressure/temperature sensor 2/
   CNG filter 2/
2. Trade name or mark .....
3. Manufacturer's name and address .....
4. Name and address of manufacturer's representative, if applicable .....
5. Submitted for approval on .....
6. Technical service responsible for conducting approval tests .....
7. Date of report issued by that service .....
8. No. of report issued by that service .....
9. Approval granted/refused/extended/withdrawn 2/ .....

1/Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).
2/Strike out what does not apply.

10. Reason(s) of extension (if applicable) .....

11. Vehicle types in which the retrofit system can be installed (M_1 and N_1 categories), or vehicle types in which the retrofit system can be installed (other categories of vehicles) and, if applicable, CO_2 and power ratios (see Addendum to this annex) .....

11.1. Emission requirements:

Regulation No. 83, ... series of amendments [3/], approval A/B/C [2/]

Regulation No. 49, ... series of amendments [3/]

12. Place: .....

13. Date: .....

14. Signature: .....

15. The documents filed with the application or extension of approval can be obtained upon request.

[2/] Strike out what does not apply.

[3/] Amendment in force at the time of the initial type approval of the vehicle or engine.

Annex 1B - Addendum

ADDENDUM TO THE COMMUNICATION CONCERNING A TYPE OF CNG RETROFIT EQUIPMENT PURSUANT TO REGULATION No. 115

(Approval No. ..... Extension No. .....)

1. Vehicles on which the retrofit equipment has been tested:

Vehicle No.	1	2	n
Make:			
Type:			
Engine:			
Power:			
Category:			

2. Test results:

Ratio CO_{2CNG} /$CO_{2\ petrol}$: [2/] .....
Ratio $Power_{CNG}$ /$Power_{\ petrol\ (or\ diesel)}$: .....

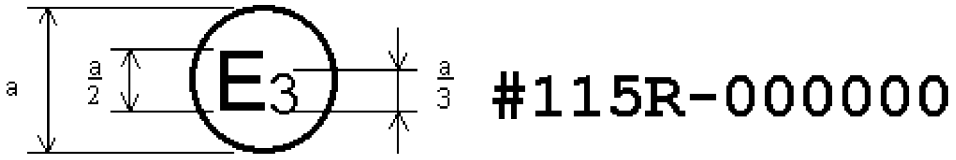
3. Vehicles type(s) for which the retrofit equipment type is qualified:

Fuel		Petrol (or diesel) [1/]		CNG	
Vehicle type	Engine type	Power kW	CO_2 g/km [2/]	Power kW	CO_2 g/km [2/]

[1/] Strike out what does not apply.
[2/] Applicable to category M_1 vehicles only.

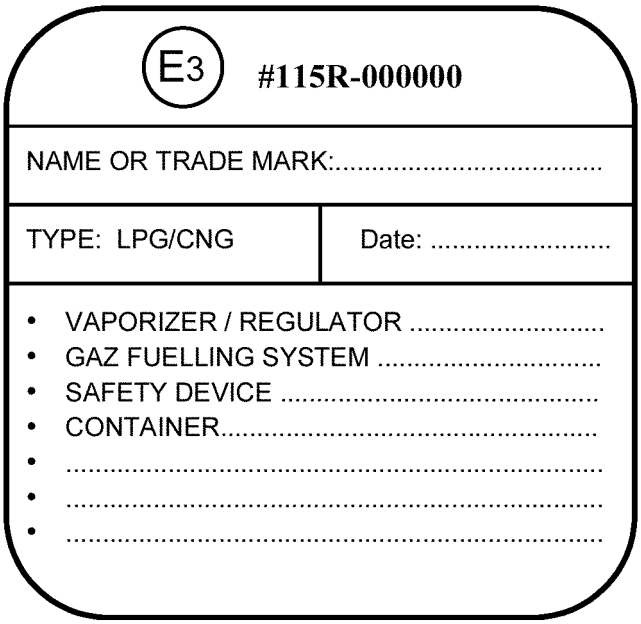
Annex 2A

ARRANGEMENT OF THE LPG RETROFIT SYSTEM TYPE APPROVAL MARK



a = 8 mm min.

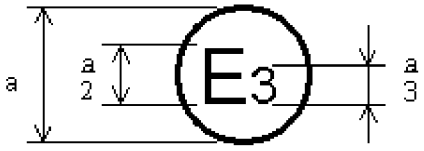
The above approval mark affixed to the plate of LPG retrofit system, shows that it has been approved in Italy (E 3), pursuant to Regulation No. 115 under approval number 000000. The symbol "#" indicates the LPG retrofit system, the first two digits of the approval number indicate that approval was granted in accordance to the requirement of Regulation No. 115 in its original form.



The above plate, with approval mark and some technical information on the retrofit system, has to be fixed permanently on the body of the vehicle.

Annex 2B

ARRANGEMENT OF THE CNG RETROFIT SYSTEM TYPE APPROVAL MARK



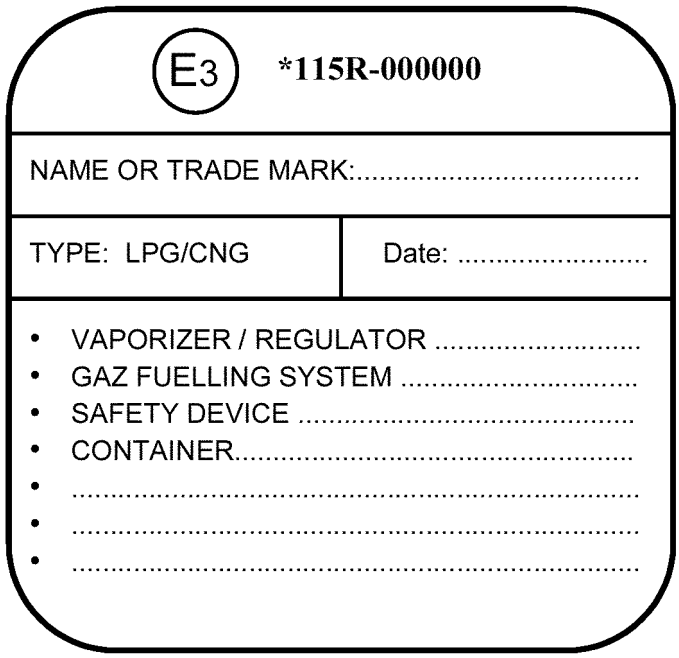
115R-00000/

a = 8 mm min

The above approval mark affixed to the plate of CNG retrofit system, shows that it has been approved in Italy (E 3), pursuant to Regulation No. 115, under approval number 000000. The symbol

"*"

indicates the CNG retrofit system, the first two digits of the approval number indicate that approval was granted in accordance to the requirement of Regulation No. 115 in its original form.



The above plate, with approval mark and some technical information on the retrofit system, has to be fixed permanently on the body of the vehicle.

*/JASIC's Note: The number should be "000000" judging from the context. However, JASIC leaves it as it is in the original document.

Annex 3A

COMPLETE LIST OF INFORMATION FOR THE PURPOSE OF THE LPG RETROFIT SYSTEM INSTALLED ON VEHICLE TYPE APPROVAL

1. Description of the parent vehicle

1.1. Name and address of the manufacturer .....

1.2. Category and identification type .....

1.3. Chassis identification number .....

1.4. Certification number .....

1.5. Internal combustion engine identification type .....

1.5.1. Working principle and thermodynamic cycle .....

1.5.2. Naturally aspirated or pressure charged .....

1.5.3. Displacement .....

1.5.4. Catalyst system type .....

1.5.5. Ignition system type .....

2. Description of the LPG retrofit system

2.1. Trade name or mark holder .....

2.2. Identification type .....

2.3. Drawing/flow-charts of the installation in the vehicle .....

2.4. Vaporiser/pressure regulator(s)

2.4.1. Make(s).....

2.4.2. Type(s) .....

2.4.3. Certification number .....

2.4.4. Identification .....

2.4.5. Drawings .....

2.4.6. Number of main adjustment points .....

2.4.7. Description of principle of adjustment through main adjustment points .....

2.4.8. Number of idle adjustment points .....

2.4.9. Description of principle of adjustment through idle adjustment points .....

2.4.10. Other adjustment possibilities: if so and which (description and drawings) .....

2.4.11. Operating pressure(s): [2/] ..... kPa

2.5. Mixing piece: yes/no [1/]

2.5.1. Number .....

2.5.2. Make(s) .....

2.5.3. Type(s).....

2.5.4. Drawings .....

2.5.5. Place of installation (include drawing(s)) .....

2.5.6. Adjustment possibilities .....

2.5.7. Operating pressure(s): [2/] ..... kPa

2.6. Gas dosage unit: yes/no [1/]

2.6.1. Number .....

2.6.2. Make(s) .....

2.6.3. Type(s) .....

2.6.4. Drawings .....

2.6.5. Place of installation (include drawing(s)) .....

2.6.6. Adjustment possibilities .....

2.6.7. Operating pressure(s): [2/] ..... kPa

2.7. Gas injection device(s) or injector(s): yes/no [1/]

2.7.1. Make(s) .....

2.7.2. Type(s) .....

2.7.3. Identification .....

2.7.4. Operating pressure(s): [2/] ..... kPa

2.7.5. Drawings of installation .....

2.8. Electronic control unit

2.8.1. Make(s) .....

2.8.2. Type(s) .....

2.8.3. Place of installation .....

[1/]Strike out what does not apply.
[2/]Specify the tolerance.

2.8.4. Adjustment possibilities .....

2.9. LPG container

2.9.1. Make(s) .....

2.9.2. Type(s) (include drawings) .....

2.9.3. Number of containers .....

2.9.4. Capacity .....litres

2.9.5. LPG fuel pump in container: yes/no [1/] .....

2.9.6. Certification number .....

2.9.7. Drawings of the installation of the container .....

2.10. LPG container accessories

2.10.1. 80 per cent stop valve:

2.10.1.1. Make(s) .....

2.10.1.2. Type(s) .....

2.10.1.3. Operating principle: float/other [1/](include description or drawings)

2.10.2. Level indicator:

2.10.2.1. Make(s) .....

2.10.2.2. Type(s) .....

2.10.2.3. Operating principle: float/other [1/] (include description or drawings)

2.10.3. Pressure relief valve (discharge valve):

2.10.3.1. Make(s) .....

2.10.3.2. Type(s) .....

2.10.4. Pressure relief device (fuse):

2.10.4.1. Make(s) .....

2.10.4.2. Type(s) .....

2.10.5. Remote-controlled service valve with excess flow valve:

2.10.5.1. Make(s) .....

2.10.5.2. Type(s) .....

[1/]Strike out what does not apply.

2.10.6. Multi-valve: yes/no [1/]

2.10.6.1. Make(s)

2.10.6.2. Type(s) .....

2.10.6.3. Multi-valve description (include drawings)

2.10.7. Ventilation housing:

2.10.7.1. Make(s) .....

2.10.7.2. Type(s) .....

2.10.8. Power supply bushing (fuel pump/actuators):

2.10.8.1. Make(s) .....

2.10.8.2. Type(s) .....

2.10.8.3. Drawings .....

2.11. Fuel pump (LPG): yes/no [1/]

2.11.1. Make(s) .....

2.11.2. Type(s) .....

2.11.3. Pump mounted in LPG container: yes/no [1/]

2.11.4. Operating pressure(s): [2/] .....kPa

2.12. Shut-off valve/non-return valve/gas tube pressure relief valve: .....yes/no [1/]

2.12.1. Make(s) .....

2.12.2. Type(s) .....

2.12.3. Description and drawings .....

2.12.4. Operating pressure(s): [2/] .....kPa

2.13. Filling point: [1/]

2.13.1. Make(s) .....

2.13.2. Type(s) .....

2.13.3. Description and drawings .....

2.14. Flexible fuel hose(s)/pipes: .....

2.14.1. Make(s) .....

[1/]Strike out what does not apply.
[2/]Specify the tolerance.

2.14.2. Type(s) .....

2.14.3. Description .....

2.14.4. Operating pressure(s): [2/] .....kPa

2.15. Pressure and temperature sensor(s): [1/]

2.15.1. Make(s) .....

2.15.2. Type(s) .....

2.15.3. Description .....

2.15.4. Operating pressure(s): [2/] .....kPa

2.16. LPG filter unit(s): [1/]

2.16.1. Make(s) .....

2.16.2. Type(s) .....

2.16.3. Description .....

2.16.4. Operating pressure(s): [2/] .....kPa

2.17. Service coupling(s) (mono-fuel vehicle without limp-home system): [1/]

2.17.1. Make(s) .....

2.17.2. Type(s) .....

2.17.3. Description and drawings installation .....

2.18. Connection to LPG system for heating system (allowed for M_2 and M_3 categories of vehicles): yes/no [1/]

2.18.1 Make(s) .....

2.18.2. Type(s) .....

2.18.3. Description and drawings of installation .....

2.19. Further documentation

2.19.1. Description of the LPG equipment and the physical safeguarding of the catalyst at switch-over from petrol to LPG or back.

2.19.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc.)

2.19.3. Drawing of the symbol

2.19.4. Adjustment data

[1/]Strike out what does not apply.
[2/]Specify the tolerance.

2.20. Cooling system: (liquid/air) [1/]

2.20.1. System description/drawings with regard to the LPG equipment

_____

[1/]Strike out what does not apply.

Annex 3B

COMPLETE LIST OF INFORMATION FOR THE PURPOSE OF THE CNG RETROFIT SYSTEM INSTALLED ON VEHICLE TYPE APPROVAL

1. Description of the parent vehicle

1.1. Name and address of the manufacturer .....

1.2. Category and identification type .....

1.3. Chassis identification number .....

1.4. Certification number .....

1.5. Internal combustion engine identification type .....

1.5.1. Working principle and thermodynamic cycle .....

1.5.2. Naturally aspirated or pressure charged .....

1.5.3. Displacement .....

1.5.4. Catalyst system type .....

1.5.5. Ignition system type .....

2. Description of the CNG retrofit system

2.1. Trade name or mark holder .....

2.2. Identification type .....

2.3. Drawing/flow-charts of the installation in the vehicle .....

2.4. Pressure regulator(s)

2.4.1. Make(s) .....

2.4.2. Type(s).....

2.4.3. Certification number .....

2.4.4. Identification .....

2.4.5. Drawings .....

2.4.6. Number of main adjustment points .....

2.4.7. Description of principle of adjustment through main adjustment points .....

2.4.8. Number of idle adjustment points .....

2.4.9. Description of principle of adjustment through idle adjustment points .....

2.4.10. Other adjustment possibilities: if so which (description and drawings) .....

2.4.11. Operating pressure(s): [2/] ..... kPa

2.5. Gas/air mixer (carburettor): yes/no [1/]

2.5.1. Number .....

2.5.2. Make(s) .....

2.5.3. Type(s) .....

2.5.4. Drawings .....

2.5.5. Place of installation (include drawing(s)) .....

2.5.6. Adjustment possibilities .....

2.5.7. Operating pressure(s): [2/] ..... kPa

2.6. Flow gas adjuster: yes/no [1/]

2.6.1. Number .....

2.6.2. Make(s) .....

2.6.3. Type(s) .....

2.6.4. Drawings .....

2.6.5. Place of installation (include drawing(s)) .....

2.6.6. Adjustment possibilities .....

2.6.7. Operating pressure(s): [2/] ..... kPa

2.7. Gas/air mixer (injector): yes/no [1/]

2.7.1. Make(s).....

2.7.2. Type(s).....

2.7.3. Identification .....

2.7.4. Operating pressure(s): [2/] ..... kPa

2.7.5. Drawings of installation .....

2.8. Electronic control unit .....

2.8.1. Make(s) .....

2.8.2. Type(s) .....

2.8.3. Place of installation .....

[1/]Strike out what does not apply.
[2/]Specify the tolerance.

2.8.4. Adjustment possibilities .....

2.9. CNG container

2.9.1. Make(s) .....

2.9.2. Type(s) (include drawings) .....

2.9.3. Number of containers .....

2.9.4. Total capacity .....litres

2.9.5. Certification number .....

2.9.6. Drawings of the installation of the container .....

2.10. CNG container accessories

2.10.1. Level or pressure indicator:

2.10.1.1 Make(s).....

2.10.1.2. Type(s) .....

2.10.2. Pressure relief valve (discharge valve):

2.10.2.1. Make(s) .....

2.10.2.2. Type(s) .....

2.10.3 Pressure relief device (fuse):

2.10.3.1. Make(s) .....

2.10.3.2 Type(s) .....

2.10.4. Remote controlled automatic valve with excess flow valve:

2.10.4.1. Make(s) .....

2.10.4.2. Type(s) .....

2.10.5. Gas-tight housing:

2.10.5.1. Make(s) .....

2.10.5.2. Type(s) .....

2.11. Automatic valve/check valve: yes/no [1/]

2.11.1. Make(s) .....

2.11.2. Type(s) .....

[1/]Strike out what does not apply.

2.11.3. Description and drawings .....

2.11.4. Operating pressure(s): [2/] .....kPa

2.12. Filling unit: [1/]

2.12.1. Make(s) .....

2.12.2. Type(s) .....

2.12.3. Description and drawings .....

2.13. Flexible fuel lines or hose(s):

2.13.1 Make(s) .....

2.13.2. Type(s) .....

2.13.3. Description .....

2.13.4. Operating pressure(s): [2/] .....kPa

2.14. Pressure and temperature sensor(s): [1/]

2.14.1. Make(s) .....

2.14.2. Type(s) .....

2.14.3. Description .....

2.14.4. Operating pressure(s): [2/] .....kPa

2.15. CNG filter: [1/]

2.15.1. Make(s) .....

2.15.2. Type(s) .....

2.15.3. Description .....

2.15.4. Operating pressure(s): [2/] .....kPa

2.16. Service coupling(s) (mono-fuel vehicle without limp-home system): [1/]

2.16.1. Make(s) .....

2.16.2. Type(s) .....

2.16.3. Description and drawings installation .....

2.17. Connection to CNG system for heating system (allowed for M_2 and M_3 category of vehicles only): yes/no [1/]

[1/]Strike out what does not apply.
[2/]Specify the tolerance.

2.17.1. Make(s) .....

2.17.2. Type(s) .....

2.17.3. Description and drawings installation .....

2.18. Further documentation

2.18.1. Description of the CNG equipment and the physical safeguarding of the catalyst at switch-over from petrol to CNG or back.

2.18.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc.)

2.18.3. Drawing of the symbol

2.18.4. Adjustment data

2.19. Cooling system: (liquid/air) [1/]

2.19.1. System description/drawings with regard to the CNG equipment

_____

[1/]Strike out what does not apply.

Annex 4

DESCRIPTION OF THE LEAKAGE TEST PROCEDURES FOR CNG/LPG SYSTEMS INSTALLED ON VEHICLES

1. Scope

To describe the procedures to be undertaken by the installer to verify the gas tightness of the system.

2. The installation of the system shall be done in accordance with the installation manual provided by the retrofit system manufacturer, Part I and II.

3. Leakage test procedure for LPG systems

3.1. When the installation has been completed, the installer shall follow the proper assembly check, paragraph 7.1.5. and the start-up procedures described in paragraph 7.1.6. After that the system has been filled-up with LPG; it is necessary to check with a gas detector or a leakage fluid detector all the fittings and connections of the system. The solenoid valves must be in open position in order to subject all the components of the system to the service pressure. No evidence of leakage is permitted.

4. Leakage test procedures for CNG systems

4.1. When the installation has been completed, the installer shall follow the proper assembly check, paragraph 7.1.5 and the start-up procedures described in paragraph 7.1.6. After that the system has been filled-up with CNG, at the service pressure; it is necessary to check with a gas detector or a leakage fluid detector all the fittings and connections of the system. The solenoid valves must be in open position in order to subject all the components of the system to the service pressure. No evidence of leakage is permitted.

Annex 5

PRESCRIPTIONS CONCERNING THE FIXATION OF LPG AND CNG CONTAINER(S)

1. The requirements of Regulation No. 67, 01 series of amendments, concerning the fixation of LPG container(s) or those of Regulation No. 110 concerning the fixation of CNG container(s) shall be deemed to be met if the container is secured to the motor vehicle by at least:

1.1. two straps per container,

1.2. four bolts, and

1.3. appropriate washers or plates if the body panels at that location are single thickness; Assuming that the material grade is Fe 370, the fixing bolts shall be of class 8.8, and have the dimensions specified in Table 1 below:

Table 1

Container content [litres]	Minimum dimensions of the washers or plates [mm]	Minimum dimensions of the container straps [mm]	Minimum diameter of bolts [mm]
up to 85	round: 30 x 1.5 round: 25 x 2.5	20 x 3 30 x 1.5	8
85 - 100	round: 30 x 1.5 round: 25 x 2.5	30 x 3 20 x 3 */	10 8 */
100 - 150	round: 50 x 2 round: 30 x 3	50 x 6 50 x 3 **/	12 10 **/
more than 150	shall meet the provisions of Regulation No. 67, 01 series of amendments, for LPG containers, or Regulation No. 110 for CNG containers		

*/In this case the container shall be secured by at least three container straps.
**/In this case the container shall be secured by at least four container straps.

2. If the container is installed behind a seat, a total clearance of at least 100 mm, in the longitudinal direction of the vehicle, shall be provided. This clearance may be divided between the container and the rear panel of the vehicle and between the seat and the container.

3. If the container straps also carry the mass of the fuel container, at least three container straps shall be provided.

4. The container straps shall ensure that the fuel container will not slide, rotate or be dislodged.

5. A protective material such as felt, leather or plastic shall be interposed between the fuel container and the container straps.

6. Container frame

6.1. If the container is secured to the motor vehicle by a container frame and container straps, the container shall be secured to the container frame by at least two container straps.

6.2. If the container straps also carry the mass of the fuel container, at least three container

straps shall be provided.

6.3. The container straps shall ensure that the fuel container will not slide, rotate or be dislodged.

6.4. A protective material such as felt, leather or plastic shall be interposed between the fuel container and the container straps.

6.5. If the cylindrical container is installed longitudinally to the vehicle, a transverse connection shall be present at the front of the container frame which is:

6.5.1. at least of the same thickness as the container frame;

6.5.2. at least 30 mm high and its top is at least 30 mm above the bottom of the container;

6.5.3. as close as possible, or even within, the domed end of the container.
By "installed longitudinally" it is meant that the axis of the cylindrical fuel container makes an angle of no more than 30 degrees with the longitudinal centre plane of the vehicle.

6.6. The container straps, washers, or plates and bolts used shall meet the provisions of paragraph 1 above.